

## **Preface**

On November 4-6, 2004, 60 Japanese and American engineers from industry, academia, government labs, and other research institutions gathered for the Fourth Japan-America Frontiers of Engineering Symposium (JAFOE) in Kyoto, Japan. Convened by the U.S. National Academy of Engineering (NAE), Japan Science and Technology Agency (JST), and the Engineering Academy of Japan (EAJ), this exciting and unique meeting included presentations and discussions of leading-edge research and technical work in four sessions: Biomedical Instrumentation and Devices, IT for the Elderly, Optical Communications, and Hydrogen Energy. The primary purpose of this book is to convey the content of the meeting through abstracts of the presentations and other meeting materials reprinted herein, as well as to inform the reader about the underpinning philosophy of the Frontiers of Engineering program.

### **Origins and Goals of the Activity**

Since 1995, the U.S. National Academy of Engineering has held an annual U.S. Frontiers of Engineering symposium that brings together 100 outstanding, early-career engineers from U.S. companies, universities, and government labs to discuss pioneering research and technical work across a range of engineering fields. The goal of the symposium series is to introduce these engineers to each other, challenge them to think about developments and problems at the frontiers of areas different from their own, and thereby facilitate collaborative work, the transfer of new techniques and approaches across fields, and establishment of contacts among the next generation of engineering leaders. The program expanded internationally with the inauguration of the German-American Frontiers of Engineering meetings in 1998. A second bilateral Frontiers program, the Japan-America Frontiers of Engineering Symposium, was started in 2000.

The JAFOE activity aims to bring together outstanding, early-career Japanese and American engineers (ages 30-45) from industry, universities, and other research institutions to introduce their areas of engineering research and technical work, thereby facilitating an interdisciplinary transfer of knowledge and methodology that could eventually lead to the development of cooperative networks of young engineers from both countries. Conferences are held annually, alternately in Japan and the United States, with about 30 engineers from each country participating. An organizing committee comprised of Japanese and U.S. engineers develops the program for the event and assists in the selection of participants.

### **Content of the 2004 JAFOE Symposium**

Dr. James Fujimoto, professor, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, and Dr. Kazuhiro Sakurada, head, Research Center Japan, Nihon Schering K.K., co-chaired the organizing committee

and the symposium. Two Japanese and two Americans gave presentations in each of the four sessions mentioned above. Presentations covered such specific topics as single-molecule views of nature's nano-machines, robot therapy for the elderly, photonic IP network technology, and new electrolyte materials for fuel cells. Speakers had been asked to tailor their talks to a technically sophisticated but nonspecialist audience and to address such questions as: What are the frontiers in their field? What experiments, prototypes, and design studies are completed and in progress? What new tools and methodologies are being used? What are the current limitations on advances? What is the theoretical, commercial, societal, and long-term significance of the work?

In addition to excellent presentations in the four topic areas, another highlight of the symposium was the dinner speech by Dr. Seiji Ogawa, director of Ogawa Laboratories for Brain Function Research, Hamano Life Science Research Foundation. Dr. Ogawa inspired the participants with his speech on MRI technologies based on his long research career in the United States. The text of his talk is included in this volume.

The meeting was designed to give an ample opportunity for discussion and networking among the participants through the Q&A sessions after each presentation in the plenary sessions as well as poster sessions that allowed each participant to showcase and talk about his/her technical work or research. In addition, cultural and technical tours were arranged, including an evening tour of Kiyomizu-dera temple in Kyoto and a visit to NTT Communication Science Laboratories.

The fifth Japan-America Frontiers of Engineering symposium is scheduled for November 3-5, 2005, in San Jose, California.

### **In Appreciation**

NAE, EAJ and JST would like to express our appreciation to our sponsors – Japan Science and Technology Agency, the National Science Foundation, the Office of the Deputy Secretary of the Army, the National Institute of Biomedical Imaging and Bioengineering, and the National Academy of Engineering Fund – for their support of this symposium. We also would like to thank NTT CSL for arranging the technical visit. Our appreciation also goes to the members of the Symposium Organizing Committee for their work in planning this event.